

Some financial aspects of
**REMOVAL OF OVERMATURE BALSAM FIR
AS A BUDWORM CONTROL MEASURE**

by T. F. MCLINTOCK
and M. WESTVELD

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SOME FINANCIAL ASPECTS OF REMOVAL OF OVERMATURE BALSAM FIR
AS A BUDWORM CONTROL MEASURE

Information thus far indicates that forest management offers the most lasting and practical means of controlling spruce budworm outbreaks. An important phase of this control program of more immediate value involves the removal of large, overmature balsam fir which provide highly favorable conditions for rapid buildup of budworm populations. On many woods operations throughout the northeast, such over-mature fir are frequently left uncut because they are deemed unmerchantable. To a large extent this practice has been established by the cutters themselves who claim that long experience combined with shrewd instinct enable them to distinguish unmerchantable trees. Through long usage this practice has become an established policy and it is now extremely difficult to get cutters to fell trees which they believe are unmerchantable. This is an unfortunate situation since there is good reason to believe that the cutters' judgment is far from infallible and that a good deal of sound wood is left standing. Because of the high budworm hazard such trees represent, they should be cut where feasible irrespective of the amount of merchantable wood they contain. Prompt and extensive application of such a program should substantially reduce effective budworm breeding conditions and hence, ultimately reduce the intensity of infestation.

To determine the commercial practicability of ridding areas of these high hazard trees, the Northeastern Forest Experiment Station is studying the cost and returns phases of such an undertaking. Specifically the Station is seeking to determine the amount of salvagable sound wood in defective balsam firs of various sizes, the costs of the various steps involved in harvesting such trees and their ultimate pulpwood value. A series of such studies is planned on typical pulpwood jobs covering a wide range of operating conditions. The present report covers the first of these experiments, conducted on a 20-acre area in Washington County, Maine on lands owned and operated by the Eastern Pulp Wood Company.

The tract selected for study constituted a very small portion of a 60-year old burn covering several thousand acres. Apparently the burn seeded in promptly and it now supports a mixed growth forest. Some idea of the structure and composition of the stand in question can be gained from a study of Table 1 which is a composite of the spruce fir elements of the forest occurring on the 20-acre area.

The study area had been marked by members of the Experiment Station staff in accordance with cutting principles aimed at increasing the resistance of the stand to attack and damage by the budworm. The marking aimed to remove spire-topped balsam fir and unthrifty trees regardless of species. Practically all thrifty spruce below 10 inches d.b.h. were retained, as well as thrifty balsam fir in the 6-8 inch diameter class. It was cut as

Table 1. Composite stand table for the spruce-fir
segment of the stand
(Dyer Town, Maine)

Number of Stems per Acre

D.B.H.	<u>Balsam Fir</u>			<u>Red Spruce</u>			<u>White Spruce</u>			<u>Totals</u>		
	Orig- inal Stand (No.)	Marked to cut (No.)	Resid- ual Stand (No.)	Orig- inal Stand (No.)	Marked to cut (No.)	Resid- ual Stand (No.)	Orig- inal Stand (No.)	Marked to cut (No.)	Resid- ual Stand (No.)	Orig- inal Stand (No.)	Marked to cut (No.)	Resid- ual Stand (No.)
6	34.4	6.7	27.7	17.6	1.0	16.6	4.0	0.1	3.9	56.0	7.8	48.2
7	27.9	13.9	14.0	14.7	1.3	13.4	3.5	0.5	3.0	46.1	15.7	30.4
8	20.9	19.1	1.8	10.9	1.4	9.5	3.2	0.4	2.8	35.0	20.9	14.1
9	12.7	12.7	-	5.9	1.6	4.3	3.4	0.6	2.8	22.0	14.9	7.1
10	8.2	8.2	-	2.4	1.5	0.9	2.1	1.4	0.7	12.7	11.1	1.6
11	5.0	5.0	-	1.3	1.2	0.1	2.0	1.8	0.2	8.3	8.0	0.3
12	2.7	2.7	-	0.8	0.8	-	1.4	1.3	0.1	4.9	4.8	0.1
13	1.2	1.2	-	0.3	0.2	0.1	1.1	1.1	-	2.6	2.5	0.1
14	0.7	0.7	-	0.1	0.1	-	0.8	0.8	-	1.6	1.6	-
15	0.3	0.3	-	0.1	-	0.1	0.2	0.2	-	0.6	0.5	0.1
16	0.2	0.2	-	0.3	0.3	-	0.3	0.3	-	0.8	0.8	-
17	-	-	-	-	-	-	0.2	0.2	-	0.2	0.2	-
Totals	114.2	70.7	43.5	54.4	9.4	45.0	22.2	8.7	13.5	190.8	88.8	102.0

Volume per Acre

Cu.Ft.	808.9	636.2	172.7	349.1	108.2	240.9	244.7	157.5	87.2	1402.7	901.9	500.8
Cords	8.52	6.70	1.82	3.68	1.13	2.54	2.58	1.66	0.91	14.78	9.49	5.27

marked by German prisoners of war under company and Experiment Station supervision.

Three pulpwood crews of five men each worked in the area and the Station assigned a man to each crew to record essential data. In the course of the operation, time studies were made on 550 balsam fir ranging from seven to sixteen inches in diameter. Time data were recorded separately for felling, limbing, skidding, bucking and piling.

It was recognized at the outset that regular woods workers normally produce more than the average output of 0.8 cords per man day by the prisoners. The difference, however, lies mainly in the amount of idle or unproductive time associated with prison labor. It is believed that the time required for one phase of the operation will bear approximately the same relation to any other phase whether regular or prisoner labor is used. Since regular cutters are normally somewhat faster and more efficient than P.W. laborers, application of time data should assure conservative results.

Procedure

In taking time records no attempt was made to obtain complete breakdown between productive, contributory and unproductive time, because: (a) "Unproductive" time was so far out of line with that of regular cordcutters that it could have no practical value, and (b) "Unproductive" and "contributory" time were so thoroughly mingled by the prisoners that an accurate separation would have been virtually impossible, especially with only three men to keep track of fifteen prisoners. For any operation recording of time began as soon as a man, or men, ceased working on one tree and began working on the next one to be timed. Time spent by the fallers in "sizing up" each tree with respect to direction of fall, in swamping around the tree, etc., as well as in dislodging, were all considered as part of felling time.

Time was recorded in man-minutes to the nearest half-minute. Stumps and ends of logs were numbered as cut so that they could be accurately followed. All wood on this operation was yarded; hence, bucking often took place at a considerable distance from the stump. The average skidding distance was about 130 feet on a gentle (10%) slope.

Bucking of timed trees at the deck afforded opportunity to check each bolt for rot. If any bolt was voluntarily culled by the crew its diameter at the small end was recorded. If it seemed possible that any bolt might be culled by the scaler, it was numbered and checked against the scaler's record at the close of the day disclosing all bolts which had been culled by the scaler. Equally detailed records were obtained for portions of the balsam fir trees left in the woods. From these records the cubic volume of culled wood was computed.

No record was kept of volume cut as the company had agreed to keep all necessary production and cost records.

Discussion of Results

For each crew average time for each operational step was computed by diameter classes. So little variation appeared among crews, however, that it was decided to combine the data for the three crews. This produced a set of overall averages for each operational step for each diameter class. These data were plotted and a curve drawn of time over diameter. Average time was read from the curve for each inch of diameter and these results are presented in Table 2.

Table 2. Average time in man-minutes for cutting operations, by diameter classes

D.B.H. Class (Inches)	Felling Minutes	Limbing Minutes	Skidding Minutes	Bucking Minutes	Piling Minutes	Total Minutes
6	5.0	3.3	3.4	5.7	1.6	19.0
7	5.8	4.9	3.9	7.8	1.9	24.3
8	6.7	6.6	4.5	9.9	2.3	30.0
9	7.6	8.3	5.2	12.2	2.5	35.8
10	8.5	10.0	6.0	14.6	2.7	41.8
11	9.4	11.9	7.2	17.8	2.9	49.2
12	10.3	13.7	8.8	22.1	3.0	57.9
13	11.2	16.1	10.0	27.5	3.2	68.0
14	12.1	18.5	11.1	33.0	3.3	78.0
15	13.1	21.0	12.0	38.5	3.4	88.0
16	14.0	23.6	12.7	44.0	3.6	97.9

Average time for piling operations is based on woods crews' piling performances. Since the procedure was to buck from two to eight trees and then to pile the accumulated bolts all at once it was impossible to make a graduated curve of piling time according to tree diameter. However, from observations of piling time throughout the operation, the average time in man-seconds per bolt was computed. The product of this average and the calculated mean number of bolts per tree in each diameter class provided the basis for calculating the average piling time by tree size classes.

Cubic feet of culled wood per acre, by diameter classes, are shown in Table 3.

Table 3. Cull in balsam fir due to decay, by diameter classes
(Based on 550 trees)

D.B.H. Class (in.)	Cull per Acre (cu. ft.)	Percent of Cull (%)
7	5.4	6.2
8	15.1	9.6
9	5.6	4.0
10	4.3	3.8
11	5.8	6.7
12	6.3	11.2
13 and up	2.3	3.4
Total	44.8	6.3

These figures were obtained by multiplying the average cull per tree in any class by number of trees per acre in that class which were cut. Also shown is the percent of merchantable total volume culled for rot by diameter classes.

The relative roadside pulpwood value of trees containing varying proportions of cull appears in Table 4. Using the total production time figures shown in Table 2., it was possible to prepare a table showing pulpwood production rates in cubic feet per minute for balsam fir 6 to 16 inches d.b.h. by tenth inch diameter classes. A second table was then prepared showing the amount of sound pulpwood produced per man minute for above sized trees containing cull ranging from 5 to 50 percent. Thus by matching equal pulpwood production rates in the two tables the size of the sound tree equivalent of a defective tree containing any specified amount of cull within the 5 to 50 percent range could be readily determined. It was then a simple matter to prepare Table 4 showing the value of different sized trees containing specified percents of cull in terms of sound trees with equivalent roadside values.

In terms of the operation as a whole, in which 7.4 cords of fir and 2.8 cords of spruce were marked for removal per acre, the half-cord of balsam fir cull represents 6.4 percent of the fir and 4.6 percent of the spruce and fir volume combined. It will also be noted that of this cull, 58 percent occurred in the seven, eight and nine-inch classes. It was quite apparent that trunk or stem rot on this area was of greater importance than

butt rot. This was especially true in the lower diameters where, in the three classes just mentioned trunk rot accounted for 64 percent of the total cull. In the larger trees butt rot was more prevalent and trunk rot less so.

The extent and quantity of cull present on the study area is not a safe guide for appraising cull on all other areas. The stand under study was relatively young; above average from the standpoints of growth and merchantable volume, and the six percent cull in fir undoubtedly is considerably lower than for the average fir stands in the region. It should be pointed out that of the 550 trees examined only seven were 60 percent or more unmerchantable because of rot, and could justifiably have been left standing. Of these only three were in the class of "overmature" fir -- the class considered a high budworm hazard. The remaining four were in the lower diameter classes. It may be concluded that on an area of this type very little justification could be found for leaving overmature fir standing because of unmerchantability. It is believed that in many cases where other such trees are left standing a considerable amount of wood could be salvaged.

In this connection Table 4. is of interest and value since it throws some light on the moot question of how much cull balsam firs of various sizes may possess and still justify harvesting them for their sound wood content. For example, the table shows that a 13-inch balsam fir containing 15 percent cull has a pulpwood roadside value equal to a sound 10-inch balsam fir; 30 and 50 percent cull factors on the other hand would place it in the value category of sound 8 and 6-inch balsam firs respectively.

Thus, if an operator's pulpwood cost production figures show that he can't profitably operate trees below the 8-inch diameter class, then according to Table 4. the maximum allowable defects in balsam firs from a profitable operation standpoint would be about as follows:

<u>Size class</u> <u>Inches d.b.h.</u>	<u>Maximum</u> <u>allowable defects</u> <u>%</u>
9	15
10	20
11	25
12	30
13	30
14	35
15	35
16	40

On the basis of the cost production premises stated above, the operator could harvest 9-inch balsam firs with rot ranging up to 15 percent at a profit, while for 12 and 14-inch balsam fir, cull would have to exceed 30 and 35 percent respectively before profit margins would disappear.

The values shown in Table 4. are considered conservative, since customarily cutters lop off the highly defective portion of the tree in the woods, thus materially reducing the amount of unproductive time involved in handling defective trees. Rot in balsam fir normally occurs either as butt rot affecting one or more of the first 3 bolts, or as top or heart rot usually affecting one to five bolts in the upper trunk. Where extensive top rot is encountered choppers often lop off the upper half of the tree, thus practically eliminating limbing time while skidding, bucking and piling time too, are greatly reduced. Under these conditions the value of a tree in terms of man minutes of labor required to convert it to pulpwood at the roadside would be materially decreased.

In large trees with butt rot, lopping off the lower section reduces skidding time, particularly if thereby the tree can be skidded in one piece rather than two, while bucking and piling time under these circumstances may register some saving. In brief, in trees larger than 11 or 12 inches, large amounts of cull in the lower section of the tree may not reduce pulpwood values to the degree shown in Table 4. while trees containing top rot only may actually increase that value.

Table 4. Roadside pulpwood value of different sized balsam fir trees with varying percentages of cull expressed in terms of sizes of sound trees with equivalent roadside values.

D.B.H. (inches)	Percent of cull in trees										
	0	5	10	15	20	25	30	35	40	45	50
	Diameter of sound tree of equivalent pulpwood value										
6	6.0										
7	7.0	6.7	6.4	6.0							
8	8.0	7.6	7.3	6.9	6.5	6.1					
9	9.0	8.6	8.1	7.7	7.3	6.9	6.5	6.0			
10	10.0	9.4	8.9	8.4	7.9	7.5	7.0	6.5	6.1		
11	11.0	10.3	9.6	9.0	8.5	8.0	7.5	7.0	6.5	6.0	
12	12.0	11.0	10.2	9.6	8.9	8.4	7.8	7.3	6.8	6.3	
13	13.0	11.8	10.8	10.0	9.3	8.7	8.1	7.6	7.1	6.5	6.0
14	14.0	12.7	11.5	10.6	9.8	9.1	8.5	7.9	7.3	6.8	6.2
15	15.0	13.7	12.5	11.3	10.4	9.5	8.8	8.2	7.6	7.1	6.5
16	16.0	14.5	13.2	11.8	10.8	9.8	9.1	8.5	7.8	7.2	6.6

On areas where unmerchantability does present a definite problem among old fir, there are several ways that the situation might be handled. It is realized that under the present labor conditions regular piecework cutters usually

refuse to cut trees which they believe to be unmerchantable unless adequately reimbursed. A feasible plan for ridding areas of these trees might be for the company to insist that all questionable balsam firs be cut and an agreed sum be paid for those containing excessive defect. For example, on the basis of an average output of 1.5 cords per man-day with a resulting wage of about \$1 an hour, and assuming 12 inches to represent the average sized "unmerchantable" tree which would otherwise be left, and allowing ten minutes to fell the tree and determine that it is a cull, the resulting cost would approximate 17¢ per tree. Another alternative would be for the company to send a crew of men behind the cutters to fall any trees left by them as unmerchantable. This crew could probably be paid on a day basis and could be required to salvage what wood was available or not as the company saw fit.

It will be seen from Table 2. that actual felling time constitutes a relatively small portion of the entire "tree conversion time", and the larger the tree the smaller is the percentage of total tree time occupied by felling. In the six-seven- and eight-inch classes, for example, felling represents approximately 25 percent of the total time required to convert the tree to pulpwood at the roadside. In the upper classes this part of the operation represents between 14 and 15 percent of the total. It seems probable that where overmature trees left after logging are to be cut solely for protection against the budworm an experienced crew of men could easily cut four trees per hour - allowing for walking between trees - and cover somewhere between 20 and 30 acres a day.

It is the plan of the Station to continue this series of studies testing the methods suggested above to obtain more specific data on cost and amount of wood salvaged. No claim is made that these high budworm hazard trees can be disposed of without some sacrifice on the part of the operator, but it is believed that further study will prove that their removal can be accomplished without undue cost and often such trees may actually pay their way.